Ocean State Estimation as a Critical Element of the International CLIVAR Program

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Oceanic observations are incomplete in space and time. Ocean models are limited in resolution and physics. Ocean state estimation provides a necessary tool to synthesize observational data with dynamical models so as to understand how the ocean works and to investigate its effect on climate variability. As such, ocean state estimation is a critical element of the International CLIVAR (Climate Variability) Program. Apart from producing optimal estimate of oceanic state to study climate variability, the procedure also offers such benefits as model testing, evaluation of data impact, observing system design, and improving estimate of air-sea fluxes, all of which being important to the implementation of CLIVAR. Ocean state estimation is essentially a least-squared fit of the model to the data weighted by the respective a priori errors. As such, knowledge of these errors dictates the final solution. Challenges in quantifying model and data errors will be addressed along with other major issues such as dynamical consistency, validation, computational efficiency versus complexity of model and assimilation scheme, interaction among modelers, observationalists, and assimilators, international collaboration, multi-disciplinary effort, and computational resources. Recent advances in ocean state estimation will be reviewed, focusing on the effort of the Jet Propulsion Laboratory as part of ECCO (Estimation of the Circulation and Climate of the Ocean), a consortium formed under the US National Ocean Partnership Program.